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PATENT & TRADEMARK OFFICE
USPTO

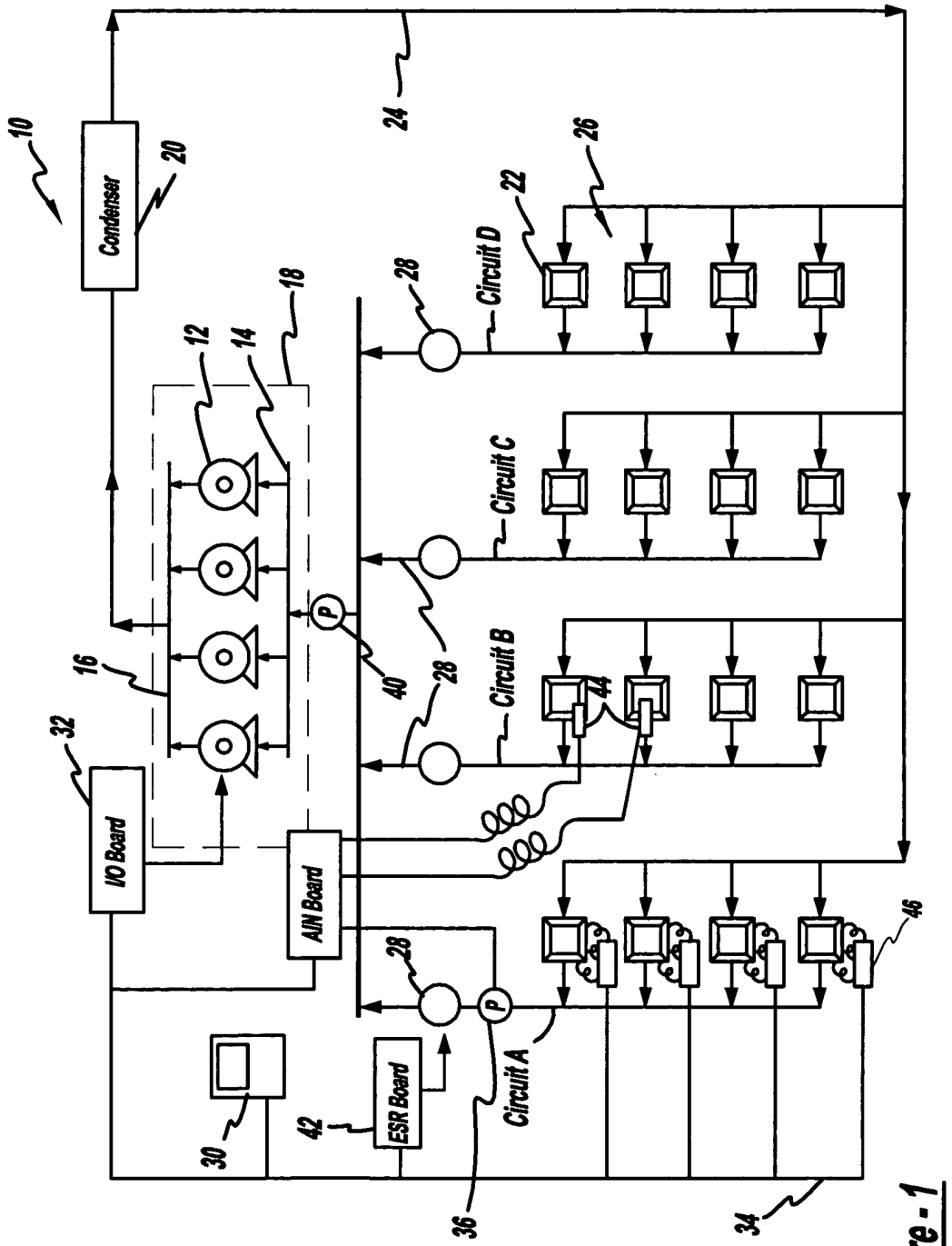


Figure - 1

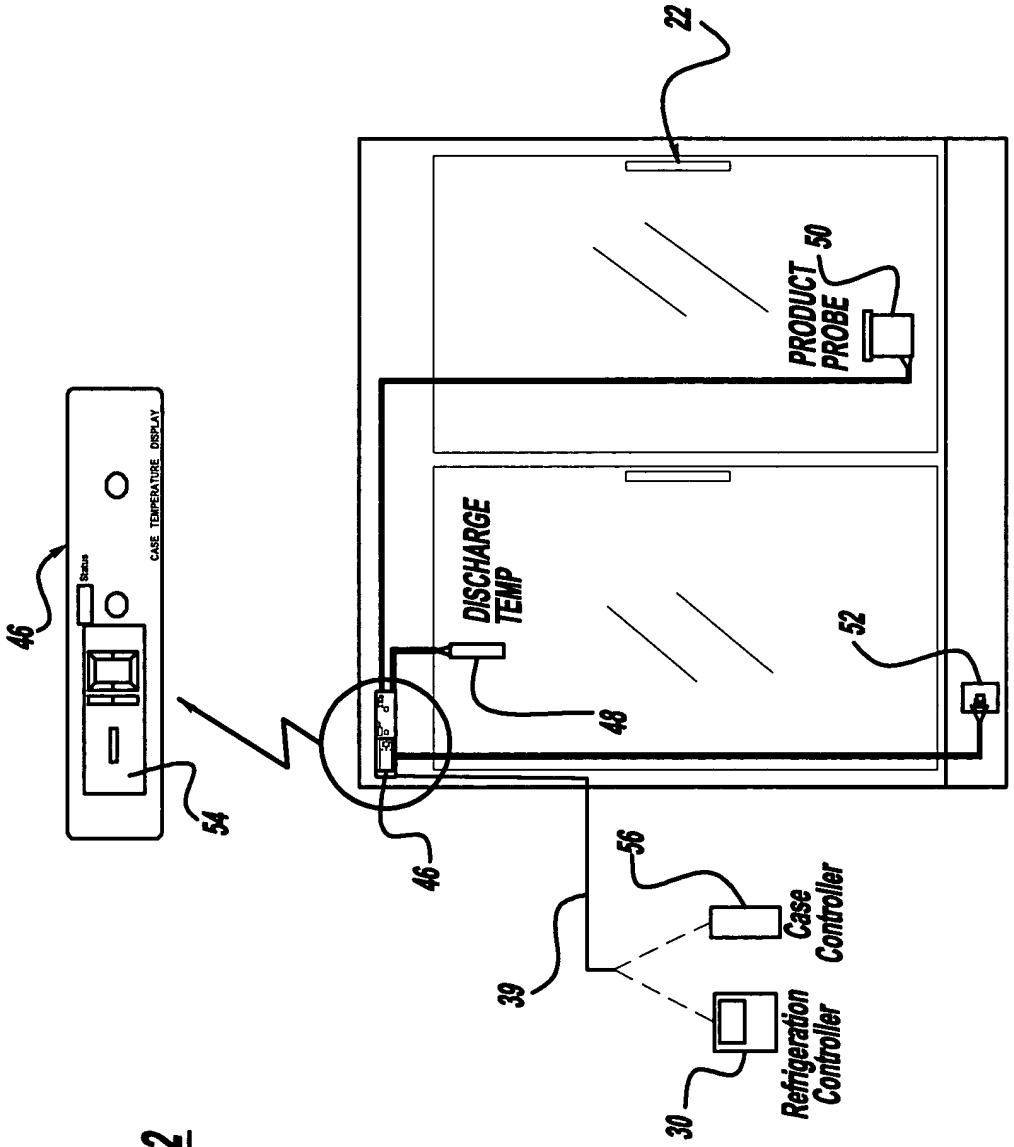

22
PRODUCT PROBE
50
DISCHARGE TEMP
48
52
46
CASE TEMPERATURE DISPLAY
Status
46
54
56
Case Controller
39
Refrigeration Controller
30

Figure - 2

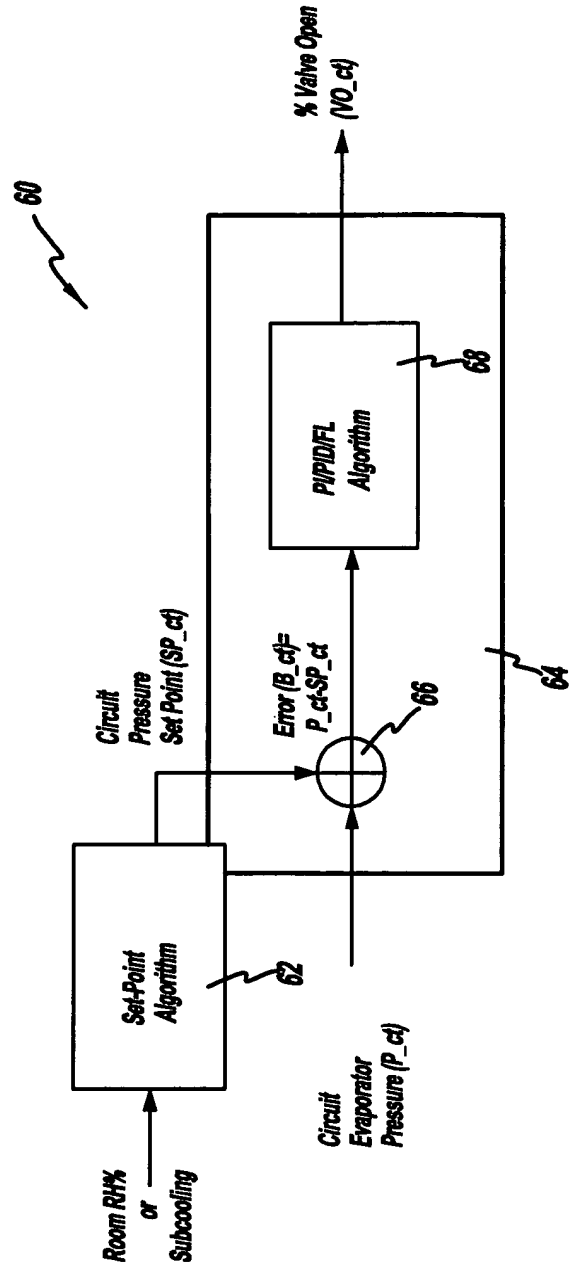

60
% Valve Open (VO_ct)
PI/PID/FL Algorithm
68
Circuit Pressure Set Point (SP_ct)
Error (E_ct)= P_ct-SP_ct
66
64
Set-Point Algorithm
62
Room RH% or Subcooling
Circuit Evaporator Pressure (P_ct)

Figure - 3

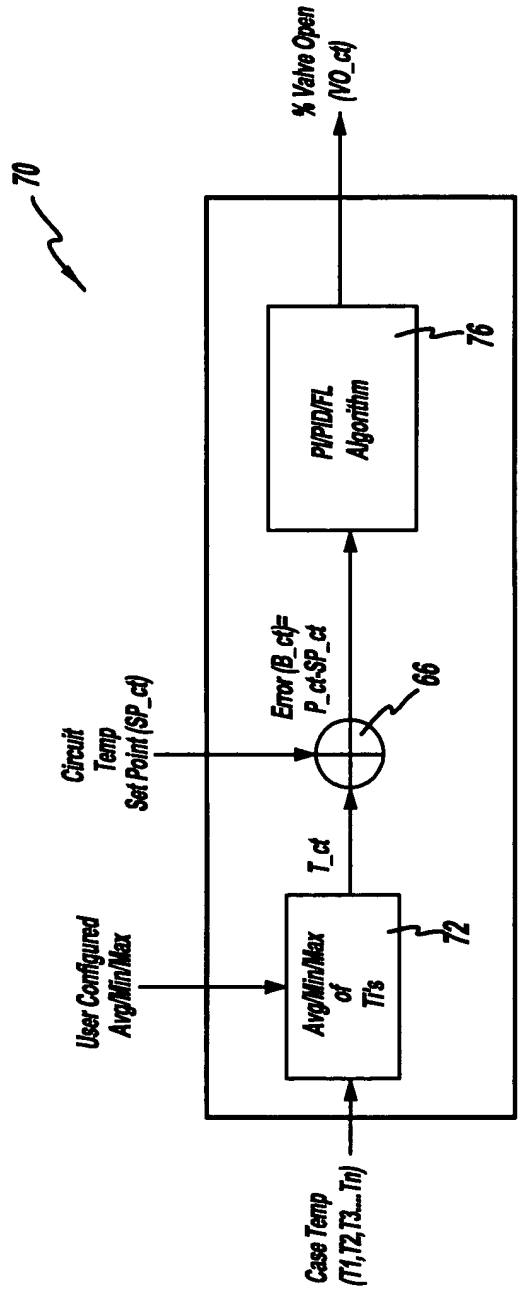

70
% Valve Open (VO_ct)
76
PI/PID/FL Algorithm
Error (E_ct)= P_ct-SP_ct
66
Circuit Temp Set Point (SP_ct)
T_ct
User Configured Avg/Min/Max
Avg/Min/Max of Tj's
72
Case Temp (T1,T2,T3.... Tn)

Figure - 4

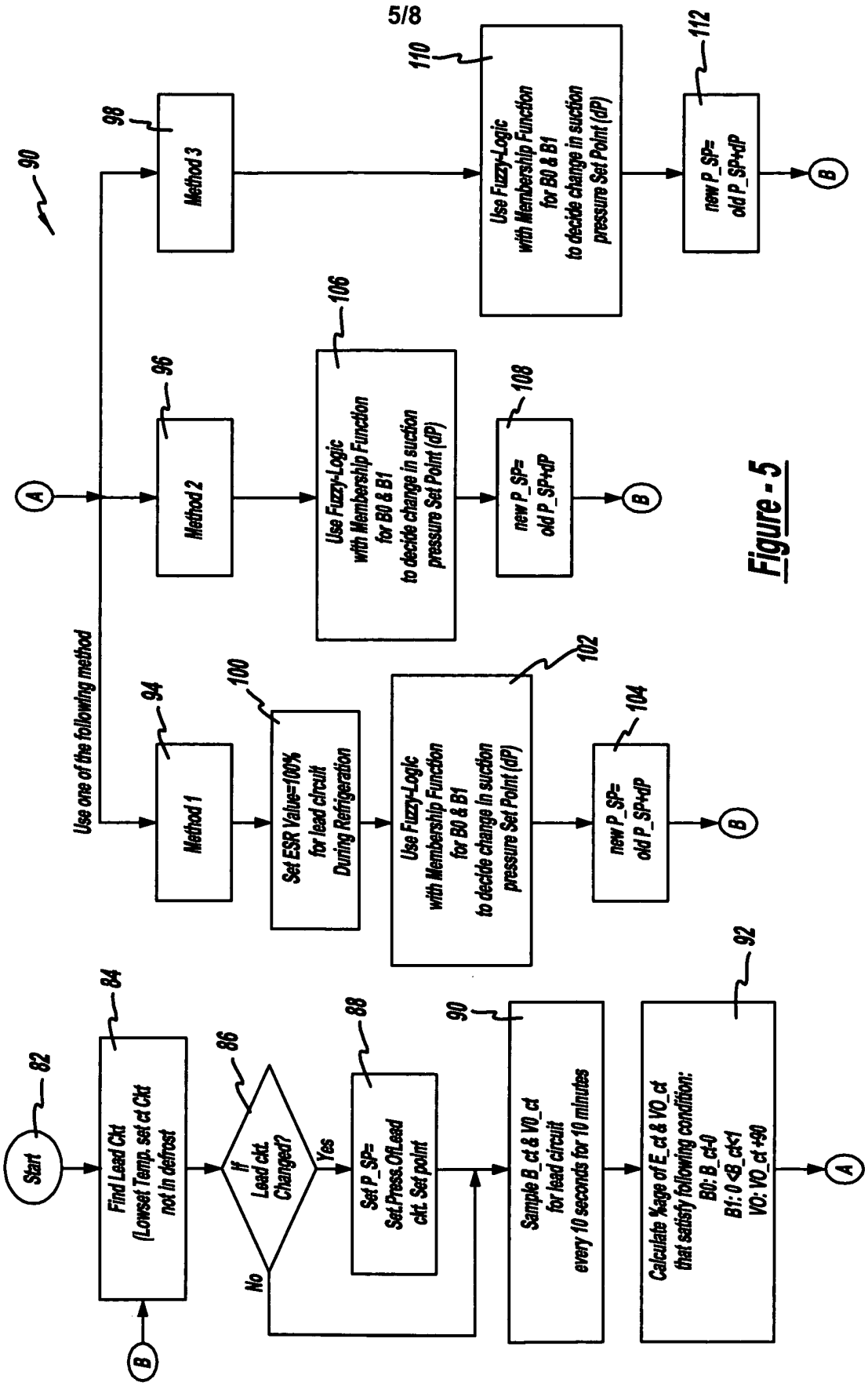
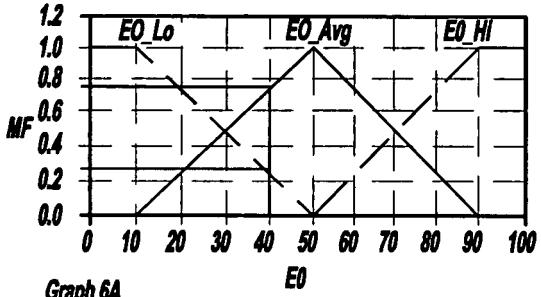

Start
82
Find Lead Ckt
(Lowest Temp. set ct Ckt
not in defrost
84
If
Lead ckt.
Changed?
86
Yes
No
Set P_SP=
Set.Press.Of.Lead
ckt. Set point
88
Sample B_ct & V0_ct
for lead circuit
every 10 seconds for 10 minutes
90
Calculate %age of E_ct & V0_ct
that satisfy following condition:
B0: B_ct>0
B1: 0 <B_ct<1
V0: V0_ct >90
92
A
B
Use one of the following method
90
Method 1
94
Set ESR Value=100%
for lead circuit
During Refrigeration
100
Use Fuzzy-Logic
with Membership Function
for B0 & B1
to decide change in suction
pressure Set Point (dP)
102
new P_SP=
old P_SP+dP
104
Method 2
96
Use Fuzzy-Logic
with Membership Function
for B0 & B1
to decide change in suction
pressure Set Point (dP)
106
new P_SP=
old P_SP+dP
108
Method 3
98
Use Fuzzy-Logic
with Membership Function
for B0 & B1
to decide change in suction
pressure Set Point (dP)
110
new P_SP=
old P_SP+dP
112

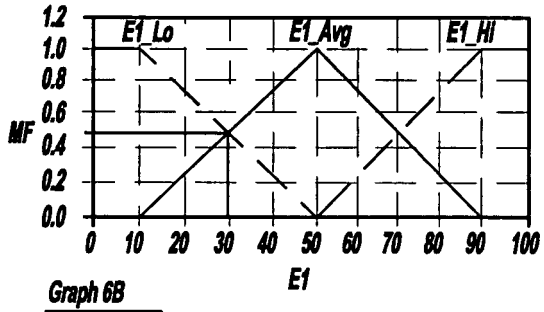
Figure - 5

Membership Function for E0



Graph 6A

Membership Function for E1



Graph 6B

Note:E0 is the percentage of E_ct that is less than zero in 10 minute duration
E1 is the percentage of E_ct that is between zero anf 1 F in 10 minute duration

Figure - 6

TRUTH TABLE 6C

	E1(J)	1	2	3
E0(I)		Lo	Avg	Hi
1	Lo	NBC	NSC	NC
2	Avg.	PSC	PSC	PSC
3	Hi	PBC	PBC	PBC

Quantity Changed:

NBC: Negative Big Change=-2 Psi
NSC: Negative Small Change=-1 Psi
NC: No Change=0 Psi
PSC: Positive Small Change=+1 Psi
PBC: Positive Big Change=+2 Psi

Sample Calculation: For E0=40%: E1=30%

Step1: Fuzzification:

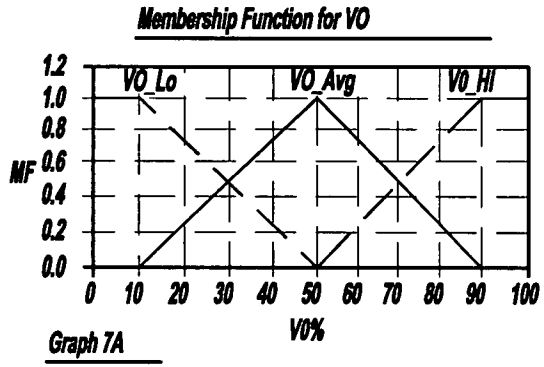
For E0=40% from Mem. Function Chart for E0 we get E0_Lo=0.25; E0_Avg=0.75
For E1=30% from Mem. Function Chart for E1 we get E1_lo=0.5; E1_Avg=0.5

Step2: MinMax: Refer to Truth Table

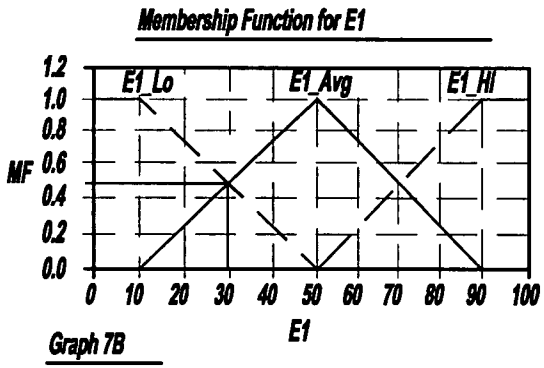
E0_Lo=0.25 and E1_Lo=0.5 ⇒ NBC=Min(0.25,0.50)=0.25
E0_Lo=0.25 and E1_Avg=0.5 ⇒ NBC=Min(0.25,0.50)=0.25
E0_Avg=0.75 and E1_Lo=0.5 ⇒ PSC=Min(0.75,0.50)=0.50
E0_Avg=0.75 and E1_Avg=0.5 ⇒ PSC=Min(0.75,0.50)=0.50
Now take maximum of common one that is PSC=0.50; NSC=0.25; NBC=0.25

Step3: Defuzzification Step:

Net Pressure set Point Change=+1*PSC-1*NSC-2*NBC/ (PSC+NSC+NBC)
=+1*0.50-1*0.25-2*0.25/ (0.5+0.25+0.25)
=-0.25



Graph 7A



Graph 7B

Note:VO is the percentage of V_ct that is less than 90% valve opening in 10 minute duration
E1 is the percentage of E_ct that is between zero anf 1 F in 10 minute duration

	TRUTH TABLE 7C			
	E1(J)	1	2	3
VO(I)		Lo	Avg	Hi
1	Lo	PBC	PBC	PBC
2	Avg.	PSC	PSC	PSC
3	HI	NBC	NSC	NC

Figure - 7

Quantity Changed:

NBC: Negative Big Change=-2 Psi
NSC: Negative Small Change=-1 Psi
NC: No Change=0 Psi
PSC: Positive Small Change=+1 Psi
PBC: Positive Big Change=+2 Psi

Serial No. 10/621,625; Atty. Ref. No. 4731-000001/COD
REPLACEMENT SHEETS

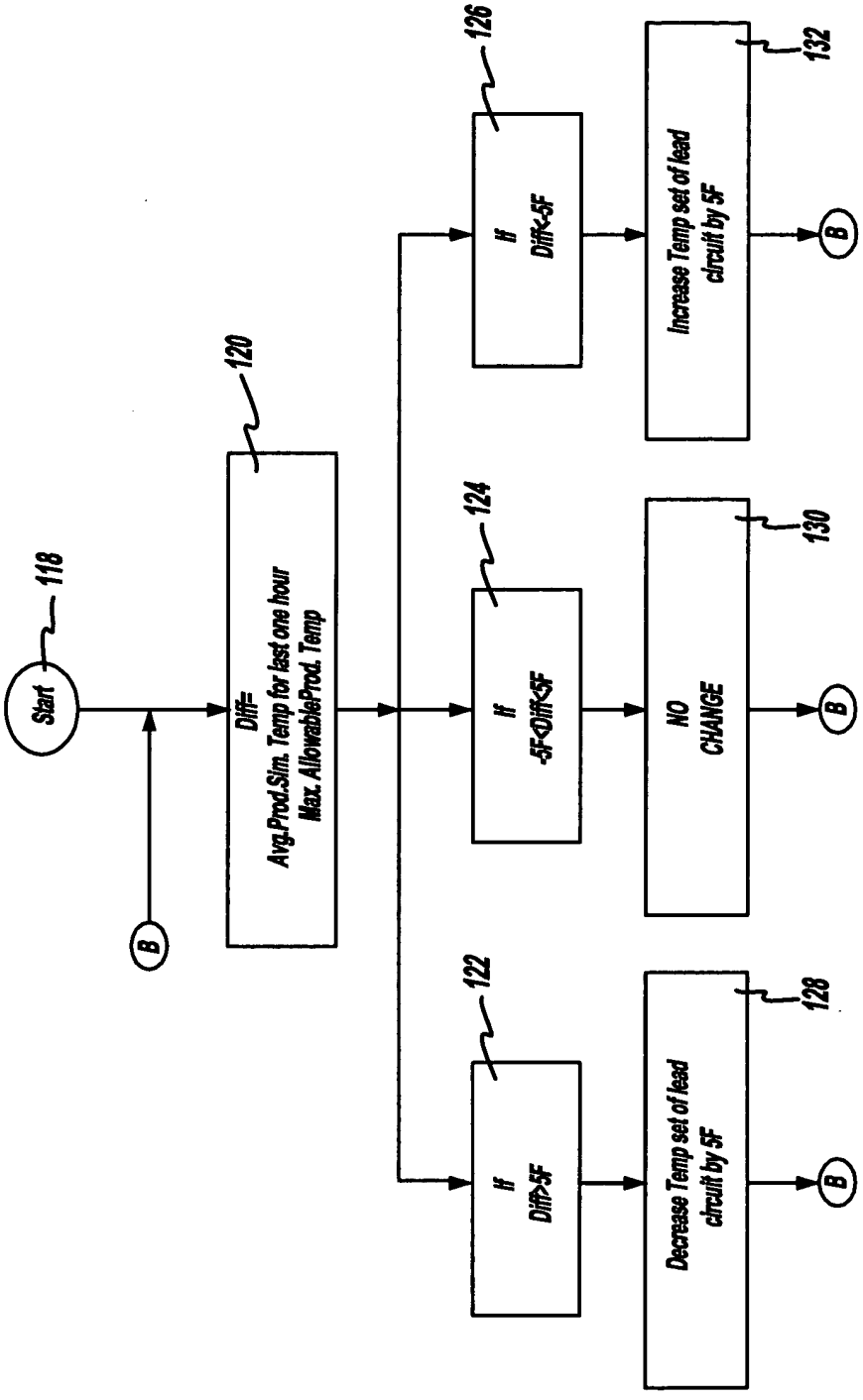

Start
118
B
Diff=
Avg.Prod.Sim. Temp for last one hour
Max. AllowableProd. Temp
120
If
Diff>5F
122
If
-5F<Diff<5F
124
If
Diff<-5F
126
Decrease Temp set of lead circuit by 5F
128
NO
CHANGE
130
Increase Temp set of lead circuit by 5F
132
B
B
B

Figure - 8